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The American STATISTICIAN

The news publication of the
AMERICAN STATISTICAL ASSOCIATION

STANDARDS OF STATISTICAL CONDUCT IN BUSINESS AND GOVERNMENT

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The **American STATISTICIAN**

FEBRUARY 1952, VOL. VI, NO. 1

The news publication of the
American Statistical Association

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LETTERS TO THE EDITOR

Some Problems for Index Number Workers

This note is prompted by several items which have appeared in *The American Statistician,* some recent publications concerning index numbers, and criticisms made of available measures during and since the last war. Its purpose is to reassert the importance of "technical" problems of measurement and interpretation which are too frequently neglected by index makers or dismissed by them as insignificant (on the basis of inconclusive tests), semantic, or "familiar." The status of index makers as "experts" has already been impaired by insufficient attention to such problems and by failure to insist on the limitations of their craft. To rehabilitate their prestige, they will certainly have to adopt a more critical attitude toward available data, conventional practices, and the uses made of their results. They will also have to show greater interest in the relationship between constructible measures and theoretically preferable ones.

A fundamental idea which ought to be more widely accepted is that general terms like (wholesale or retail) price, production, or productivity imply families of related concepts and hence cannot be represented by unique measures.[1] Different choices of data, commodity classifications, formulas, and weights amount to different operational definitions of such terms. Each combination makes some sort of sense; and none is "best," "right," or "wrong" without reference to a purpose, context, or use. The stipulation of algebraic or other conditions to be satisfied by an acceptable index could rule out all but one or a few of the measures which are plausible *a priori.*

It ought also to be conceded that index numbers are essentially arbitrary. Being at best rearrangements of data wrenched out of original market and technological contexts, they strictly have no economic meaning. Changes in tastes, technology, population composition, etc. over time increase their arbitrariness. Furthermore, the factoring of, say, a value index into price and quantity measures does not really segregate the changes "due to" these two entities. But, of course, there is no bar to the use of indexes "as if" they did have some unequivocal meaning—provided the users remember that they themselves made up the game and do not threaten to "kill the umpire" when the figures contradict expectations.

The limitations of the techniques of deflation are not sufficiently appreciated.[2] This technique cannot yield a satisfactory result by indirection if a direct approach does not suggest a conceptually clear measure in the first place. To satisfy the requirements of verbal algebra is not enough. It is also not generally understood that deflation of a value index by a price

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NEWS

Election of Fellows—National registration of social scientists—Scientific societies elect new officers—Meetings and summer conferences—Federal statistical activities—New publications

National Registration — The Humanities and the Social Sciences

The American Council of Learned Societies is at present preparing a national register of specialists in the humanities and the social sciences. This project is being done under contract with the Office of Naval Research representing the interests of three military services. The last time that this was attempted, during World War II, the fields of the social sciences were not adequately covered, and the present survey is attempting to get complete data from all of the recognized social sciences of the United States.

Under the present plans members of the American Statistical Association and others professionally working in the field of statistics will receive, during the spring of 1952, a questionnaire designed to provide a record of specialization and experience.

The American Statistical Association is cooperating with the American Council of Learned Societies in carrying out this registration, and we urge our members to assist in making the project complete by filling out the questionnaire prompty and conscientiously. The Council has assured the Association that the data obtained from the questionnaire will be made available to the Association's office and that we will, therefore, have for the first time in the history of our Association a complete, detailed and accessible roster which may be used whenever the specialized talents of our membership need to be called upon.

International Statistical Institute Elects New Officers

At the business meeting of members of the International Statistical Institute, which was held on December 11, 1951, at New Delhi, the following officers of the Institute were elected: President, Stuart A. Rice (United States); Vice Presidents, R. C. Geary (Eire), P. C. Mahalanobis (India), J. L. Rueff (France), M. A. Teixeira de Freitas (Brazil); Secretary General, Ph. J. Idenburg (Netherlands); Treasurer, R. G. D. Allen (United Kingdom).

The Government of Italy has invited the International Statistical Institute to hold its next regular meeting in Rome. The invitation was unanimously accepted by the general assembly of ISI, but the date has not yet been set.

Eastern North American Region of the Biometric Society Elects Officers for 1952

The Eastern North American Region of the Biometric Society held its fourth annual meeting in Boston on December 27-29, 1951, jointly with the Biometrics Section of the American Statistical Association and the Institute of Mathematical Statistics. At the regional business meeting on December 29, the following officers were named for the year 1952: Vice President, H. W. Norton; Secretary-Treasurer, W. T. Federer; members of the Regional Committee, D. B. Duncan and H. C. Batson.

The American Statistical Association Announces New Fellows

The Committee on Fellows of the American Statistical Association announced the unanimous election of the following outstanding statisticians as new Fellows of the Association:

Richard Loree Anderson: An original contributor to serial correlation theory and active in teaching and research in economic and experimental statistics.

William Forrest Callander: A leader in the improvement of statistical methods during his administration of the U.S.D.A. Division of Agricultural Statistics and the organizer of a Statistical Laboratory at the University of Florida.

Jerome Cornfield: Accomplished in diverse fields of application of statistics. His studies of finite sampling were applied to family spending and saving in wartime. Pioneer work in the input-output techniques is extensively used in the Air Forces. His interests now are in the application of statistics to medical research.

Besse Beulah Day: Diligent in the applications of statistical theory to the two widely separated fields of forestry and engineering.

Daniel Bertrand DeLury: A contributor to the theory of statistics with wide experience in the applications to biological problems, including the estimation of fish populations.

Paul Sumner Dwyer: A distinguished contributor to the theory of inverting matrices and solving systems of normal equations and the author of a recent book on numerical computation.

David John Finney: Recognized for his pioneer work in fractional replication of factorial experiments and for developing techniques useful in

estimating linkage in human genetics. His critical investigations in biological assay are included in a recent book on the subject.

Harold Adolph Freeman: Influential in introducing sound statistical methods into engineering and industrial fields. Widely known as teacher and author and as an effective worker in the American Statistical Association.

Emil Julius Gumbel: His researches on the distribution of extreme values have profoundly affected practices in the Geological Survey and in the Soil Conservation Service, and have been valuable in the design of dams for flood control.

Paul Gerhard Hoel: Research in approximation theory and computational errors and author of a well-known book on mathematical statistics.

Vladimir Stepanovitch Kolesnikoff: Internationally known for his work in the standardization of industrial, commodity and trade classifications.

Margaret Merrell: An extensive contributor to mathematical biology and a successful developer of the Life Table Method.

Bruce D. Mudgett: A leader of graduate research in economics and statistics and an author of numerous books and articles on economics and insurance including a recent book on index numbers.

K. R. Nair: One of the world's leaders in the construction and properties of incomplete block designs.

Henry Scheffe: Widely known for his applications of statistics to problems of engineering and the physical sciences, and a contributor to the theory of the testing of statistical hypotheses.

Henry Soladay Shryock: A sociologist who has achieved authority in demography, with emphasis on internal migration, as well as in the design of surveys and the analysis of the resulting data.

Gerhard Tintner: Of world-wide repute as an exponent of the variate-difference method for treating economic time series and a leader in the present-day advances of econometrics.

Jacob Wolfowitz: One of the leading contributors to non-parametric statistics, to sequential analysis, and to the theory of decision functions. His services to the Association include an interim editorship of the *Journal.*

William John Youden: An inventor of experimental designs and an exponent of ingenious applications of statistics to research in chemistry.

GEORGE W. SNEDECOR, *Chairman*
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Summer Sessions in Berkeley, California

This year's summer program at the Statistical Laboratory of the University of California, Berkeley, California, consists of two sessions, June 23 - August 2 and August 4 - September 13.

The program includes two of the usual undergraduate courses, one in each session, as well as one new course in each session. In the first session the new course being offered is called: "Statistical methods of searching for causal relationships." The course is designed to acquaint the students with statistical methods of approaching practical problems with particular reference to correlation and causality and to the pitfalls which studies of this kind frequently involve.

The faculty of the summer sessions will include Dr. Grace E. Bates, Assistant Professor, Department of Mathematics, Mt. Holyoke College, South Hadley, Mass.; Professor J. Neyman, Dr. E. Fix, Dr. G. Kallianpur, Mr. L. LeCam, of the Statistical Laboratory, University of California. Professor J. Neyman will be available for consultations on work leading to higher degrees.

American Society for Quality Control, Sixth Annual Convention

The American Society for Quality Control will hold its sixth annual convention in Syracuse, N. Y., May 22 through 24, 1952. In addition to the discussion of quality-control work in a variety of industrial fields, there will be technical discussions on applications of mathematical statistics in industry, and eleven hours of instruction in the basic principles of quality control.

Exhibits will include those of many of the country's foremost manufacturers, showing important phases of quality-control activities in their operations.

Eastern Business Teachers Association Meets April 10-12

The Eastern Business Teachers Association extends to all members of the American Statistical Association a cordial invitation to attend its annual convention at the Hotel Statler, Buffalo, N. Y., April 10 to 12, 1952.

The theme of the convention is "Business Education for Life Adjustment: Vocational, Personal, Social." Special sectional meetings are being provided to serve college, private-school, and secondary-school interests.

The $3 membership fee includes free registration at the convention; subscription to the quarterly magazine, *American Business Education;* and a copy of the cloth-bound yearbook to be published in June 1952.

A copy of the advance program may be obtained by writing the Secretary, Bernard A. Shilt, Board of Education, City Hall, Buffalo, N. Y.

A. Ross Eckler Appointed to Committee on Fellows

The retiring President of the Association, Lowell J. Reed, announced the appointment of A. Ross Eckler, Deputy Director, Bureau of the Census, as a member of the Committee on Fellows for the term 1952 through 1956. The Committee during 1952 will consist of Lester S. Kellogg, *Chairman;* W. Edwards Deming, Frank W. Notestein, William G. Cochran and A. Ross Eckler.

Columbia University to Hold Conference on Industrial Research

The 3rd Annual Conference on Industrial Research will be held at Columbia University June 9th through June 13th, 1952. The Conference, which is under the sponsorship of the Columbia Center for Studies of Research Administration, has as its theme this year "The Design of Research Operations."

An outstanding program of speakers on the design of research facilities, research projects, programs, design of experiments, and operations research has been arranged.

Inquiries concerning the Conference should be addressed to Professor David B. Hertz, 409 Engineering Building, Columbia University, New York 27, N. Y.

The University of North Carolina Announces the Granting of Degrees in Mathematical Statistics

Ph.D. degrees in Mathematical Statistics were granted to:

Gopinath B. Kallianpur, *Some topics in the theory of stochastic processes.*

Ingram Olkin, *On distribution problems in multivariate analysis.*

William Stokes Connor, *The structure of balanced incomplete block designs and the impossibility of certain unsymmetrical cases.*

Milton Everett Terry, *Some rank order tests which are most powerful against specific parametric alternatives.*

M.A. degrees were granted to:

Marcus Glenn Singleton, *Linear regression and double sampling.*

Morris Skibinsky, *Test of a hypothesis concerning gonial crossing over.*

Marvin Zelen, *Bounds on a distribution function which are a function of the first four moments.*

Biostatistics Conference

June 16 - July 23, 1952
Iowa State College, Ames, Iowa

A biostatistics conference has been scheduled for the first session of the 1952 summer quarter at Ames, sponsored by faculty members working in agriculture, biology and statistics at Iowa State College and by The Biometric Society (ENAR). The subject matter of the five-week conference is arranged so that many who cannot attend the entire conference can advantageously come for one or more of the weeks. Iowa State College is giving the Conference financial support. Publication in book form is intended.

The plan of the program is that each morning a biologist will present a problem, outline the objectives, describe techniques suitable for the experiment and analysis. A paired statistician will discuss suitable experimental designs and statistical and mathematical methods for attacking the problem. These speakers will preside at a general discussion period of the same topic the same afternoon. Similar discussion periods proved quite helpful in clarifying the contents of papers presented at the morning sessions in the Heterosis Conference at Ames the summer of 1950. Evening discussion groups or workshop meetings are also possible.

The program is tentatively arranged in five somewhat separate weekly units as follows:

First week: Development of Quantitative Biology
Second week: Specification of Populations and Their Processes
Third week: The Estimation of Populations
Fourth week: Individual Growth
Fifth week: Biomathematical Mechanisms Within the Individual and Species

Invited speakers include: Edgar Anderson, Geoffrey Beall, Joseph Berkson, Chester I. Bliss, P. W. Bridgman, Samuel Brody, C. West Churchman, William G. Cochran, C. C. Cockerham, Jerome Cornfield, Charles W. Cotterman, James F. Crow, S. L. Crump, D. B. DeLury, Gordon E. Dickerson, Harold F. Dorn, A. M. Dutton, W. T. Federer, Robert P. Gage, C. B. Godbey, A. A. Hasel, P. G. Homeyer, John W. Hopkins, H. Hotelling, S. Isaacson, O. Kempthorne, H. H. Kramer, Warren Leonard, Howard Levene, H. L. Lucas, S. E. Luria, J. L. Lush, William G. Madow, Walter M. Meyer, Lloyd Miller, H. J. Muller, H. C. Murphy, Jerzy Neyman, H. W. Norton, Thomas Park, N. Rashevsky, A. S. Rosenblueth, L. W. Scattergood, Franz Schrader, John P. Scott, G. W. Snedecor, G. W. Stewart, P. C. Tang, D. J. Thompson, John W. Tukey, A. S. Wiener, Norbert Wiener, Frank Wilcoxon, Edwin B. Wilson, Sewall Wright, M. R. Zelle, J. A. Zoellner. Early responses indicate that most of these can take part. Some revision of the topic and of their time arrangement will doubtless be necessary when replies have been received from all.

It is expected that the Conference will be of interest to advanced undergraduates, graduate students, and to research workers in the various biological sciences and statisticians who are interested in statistics as a research tool. Some graduate credit in Statistics will be allowed for attendance and study during the Conference.

Rooms will be available in the college dormitories at the usual rates. For more detailed information write: T. A. Bancroft, Director, Statistical Laboratory, Iowa State College, Ames, Iowa.

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Federal Statistical Activities

Population Estimates for Civil Defense Planning

The Bureau of the Census has undertaken to prepare, for the Federal Civil Defense Administration, estimates of daytime and nighttime population by zones within specified cities. The cities included in the study are selected from those cities within Standard Metropolitan Areas which had 40,000 or more persons employed in manufacturing establishments, according to the 1947 Census of Manufactures. In addition, Washington, D. C. has been included in the project.

Estimates are being prepared for two types of zones:

1. For a group of 69 cities, the zones are defined as concentric rings at intervals of a half-mile, centered on the downtown congested district of the city and extending out to a distance of 4 miles or the city limits (whichever is closer). Groups of census tracts intended to approximate these zones were established to serve as the basis for preparing population estimates.

2. For a group of 117 cities (including the 69 cities mentioned above), the zones are defined as commercial, industrial and institutional areas with relatively high concentrations of population. These zones were delineated by field supervisors of the Bureau, under rules established with the Federal Civil Defense Administration, in a mapping project conducted with the assistance of local civil defense and other local officials. Combinations of census tracts intended to approximate the delineated areas were then established for purposes of preparing population estimates.

The estimate of nighttime population in any zone is taken to be the sum of the resident population from the 1950 Census and an estimate of the transient population in hotels, in the approximating group of census tracts.

To construct an estimate of the daytime population in any zone, computations are again carried out on the basis of the approximating group of census tracts. Starting with the resident population in these tracts, there is subtracted the Census count of persons in the labor force, and an estimate of the number of residents away from home for reasons other than school or employment. To this net figure there is then added an estimate of the number of persons employed in these tracts, and the number of persons present for reasons other than employment or school (shoppers, transients in hotels and other visitors, etc.). These estimates are constructed on the basis of special tract tabulations from the 1947 Census of Manufactures and the 1948 Census of Business; materials collected locally through Census field offices; and assumptions established with the Federal Civil Defense Administration. Persons in institutions and, because of the size of the tract groupings, children in school, are assumed to remain within the area.

The Federal Civil Defense Administration will use these population data to construct estimates for planning purposes, of numbers of potential casualties under bombing attacks, needs for bomb shelters, and the like.

LOWELL T. GALT
Field Division, Bureau of the Census

AMONG RECENT STATISTICAL PUBLICATIONS

Bureau of the Census, Department of Commerce

Statistical Abstract of the United States—1951 Edition

A summary compilation, in one volume of the more significant statistics of the United States, including statistics from all Federal agencies which produce statistics, as well as from many private sources. Among the new series included for the first time in the 1951 edition are a group of tables on advertising expenditures, bringing together data from a number of private sources, and several tables on concentration of output and on mergers and acquisitions. Also included are a summary of the final statistics from the 1948 Census of Business, and new material on dwelling units from the preliminary reports of the 1950 Census of Housing, on distribution of personal income, and on Federal Government expenditures for credit programs, civil works and aid to State and local governments. 1047 pp.

Available at $3 a copy (bound in buckram) from Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Bureau of the Census, Department of Commerce

Key to Published and Tabulated Data for Small Areas

An index, in tabular form, to the statistics available from the 1950 Censuses of Population and Housing for various types of areas smaller than States. The information is cross-indexed to the specific tables in which the published data on the subject will appear in the final Census reports. Also included is information which will be available in the form of unpublished tabulations, with the procedure for obtaining information of this type. Appendixes describe and list various types of areas, such as standard metropolitan areas, urbanized areas, census tract areas, and block statistics cities. 50 pp.

Available at 30 cents a copy from Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Federal Trade Commission

List of 1,000 Large Manufacturing Companies, Their Subsidiaries and Affiliates, 1948

A list of 1,000 large manufacturing companies, with their 7,557 subsidiary and affiliate companies, ranking parent corporations as to size on the basis of total assets in 1948 and showing the percentage of stock interest held by the parent corporation in each subsidiary or affiliate. The companies are grouped in 21 major industries, in accordance with the Standard Industrial Classification. The listing was prepared by the Federal Trade Commission to aid in its studies of economic concentration, and has been made available as a useful tool for other statistical studies. 225 pp.

Available at $1 a copy from Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Bureau of Labor Statistics, Department of Labor

Handbook of Labor Statistics—1951 Edition

Basic Bureau of Labor Statistics series and related figures compiled by other Federal agencies, arranged in twelve major sections: Employment, unemployment and pay rolls; labor turn-over; earnings, hours, and wage rates; prices and cost of living; industrial relations; output per man-hour and unit-man hour requirements; work injuries; building and construction; housing and rents; social security and related programs; consumers' cooperatives; and production, income, and expenditures. Historical figures included insofar as available. First issue since 1947 edition. 239 pp.

Available at $1.25 a copy from Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Productivity Trends in Selected Industries, Indexes Through 1950

Productivity indexes on 35 industries and industry groups in the fields of manufacturing, mining, public utilities, and agriculture, assembled in one volume. The book contains 95 series on output per worker and per man-hour, as well as many series on production, employment, man-hours, and unit labor requirements. Tables for most of the manufacturing industries cover the period 1939-50. Measures for the individual mining and public utility industries generally go back to 1935, and those for the mining group and for agriculture cover more than three decades. In addition to the index table the report contains a section of technical notes explaining the methods used to construct each index. BLS Bulletin No. 1046. 83 pp.

Available at 45 cents a copy from Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Standards of Statistical Conduct in Business and Government

The papers presented here were given at a session of the Annual Meeting of the American Statistical Association held in Boston in December 1951. The session was sponsored by the Business and Economic Statistics Section of the Association and was under the chairmanship of Martin Gainsbrugh of the National Industrial Conference Board.

Statistical Standards

by ANDREW T. COURT

Any definition of STANDARDS of conduct for the statistical profession should emphasize specifics rather than dwelling on honesty, loyalty, and dependability, which apply with equal force to all human endeavor.

Tremendous over-simplification is one characteristic of economic statistics. Typically, a massive complex of facts and guesses is condensed into THE NUMBER, which is then labeled with "National Income" or "Ingot Capacity" or some other abstract phrase. The result is useful because it is compact.

To accomplish this dramatization, the statistician must early decide what can be left out of his figures and the accompanying description without seriously misleading those who are likely to use his results. To do this, he must consider the possible uses and misuses of the specific material in light of the probable users' interests. Simplification without deception is the goal. Labels are often more important than methods of compilation.

In the light of these observations, the following conduct might be recommended:

I. Statistical series which are frequently misunderstood should be redefined. For example, the Cost of Living Index of the BLS was renamed the Consumers' Price Index, to make a common misinterpretation more difficult. The earlier title had given many the impression that changing standards of living were measured.

II. Data which lack a valid conceivable use should not be published. Presentation implies significance. It is worse than just a waste of space to print the insignificant statistic. For example, VALUE OF PRODUCT total for all manufacturing industry was largely the product of inter-establishment double counting. There was no valid use to which it could be put. The Census wisely suspended publication of this figure.

III. Descriptive qualifications listed in titles or footnotes must be the most important from the viewpoint of most users. Since all the qualifications can never be published, the inference is that any unpublished qualifications are less important for most users than those which are published.

These items illustrate specific guides to conduct which seem to be more useful than broad ethical generalizations.

DISCUSSION: J. E. MORTON

There can be no question that the statistician, like any other professional worker, should adhere to recognized standards of professional performance. However, different types of statistical performance create different problems of conduct. From this point of view, practicing statisticians can be divided into three broad groups:

1. *The statistical theorist.* Whether engaged in the application of probability theoretical models to the study of distribution functions or in the development along other lines of principles whose use will produce "better," more efficient and more accurate statistics, he resembles the craftsman of the guild society. His pride in and responsibility for the final product, together with the mores and folkways of his society have assured a high level of performance, of intellectual honesty, and of professional and scientific ethos. We need not concern ourselves with his conduct and with standards of his performance.

2. *The statistician — subject matter analyst.* His classical representative is the statistical geneticist who ideally is responsible for both, the setting of the hypothesis and its test. In more recent times the research worker who is engaged in operations research combines statistical method and subject matter in a similar way. The fact that this type of activity combines responsibility for all phases of the work in one and the same person makes it extremely unlikely and very dangerous for the research worker himself to adhere to standards of performance in some but not in other phases of his work. Problems of statistical conduct, therefore, will seldom become acute.

3. *The fact-finding statistician.* He is the person who specializes in observation and description of statistical mass phenomena, communicating their results to others for analysis, interpretation, and use. As the scope and size of such operations has increased, the division of labor between the ob-

server and the interpreter has become more pronounced and sharper. Since, frequently, he is the one who in the public eye is made responsible for the results of the final analysis of the data and for other people's decisions which are based, in fact or by implication, on his observations, the problem of statistical standards is most acute in connection with his work. Thus the question of standards of conduct becomes important both as a morale builder and as a protective device.

In such a complex situation of divided responsibilities and loyalties, adherence to standards does not necessarily grow smoothly and develop automatically. Hence, even the discussion in operational terms of questions of "conduct" makes it necessary to fulfill specific prerequisites.

First, standards have to be developed. Apart from broad and self-evident rules of conduct, standards of performance in an area which is as complex and difficult as statistics are by themselves a major problem for inquiry, research, and analysis. In fairness to the Division of Statistical Standards of the Bureau of the Budget, it should be acknowledged that this Division has been more active and successful in the development of standards than any professional or scientific society in this country or abroad.

Secondly, once standards have been developed (and standards may not necessarily be consistent with each other), there is the problem of agreeing on a particular set of standards. It is along these lines that a professional association could contribute a great deal of really valuable service.

Thirdly, after standards are agreed upon, we face the delicate question of how to translate such standards into practice. I suspect that much of the discussion of statistical conduct has this last phase in mind, taking for granted the preceding ones. Though it is quite true that this last phase commands most attention on the part of the public and gives rise to the bitter criticisms of "statistics" and "Statisticians," it is my feeling that frequently such criticism is unnecessarily cruel and unjustified. Since it is in many instances the economist or another subject matter specialist who draws the inferences or uses the data for writing a brief which comes to the attention of the public, the problem of standards of conduct concern him rather than the statistician. It is quite conceivable and not at all unusual that perfectly good statistics are being misused for obvious reasons and sometimes not quite obvious reasons. As long as the fact-finding statistician will not only have little influence on the ultimate use of the data, but will frequently be kept ignorant about the specifications of the product which he supposedly produces, even ideally perfect standards and adherence to them by the statistician will hardly make for substantial improvement. In practice, the honest statistician will be confronted with a dilemma similar to that of the unfortunate doctor in Shaw's play. He might, of course, refuse to provide information if he knows or suspects that the use to which this information may be put is unwarranted by the quality of the data. However, it would be unduly harsh on the statistician to expect from him such heroic and suicidal behavior. Much, therefore, remains to be done by his professional associations in the direction of educating the public concerning the function and scope of statisticians. Last, but not least, it has to be stressed again and again how important it is to educate employers to the fact that mere figures are not statistics and that the successful production of valid and efficient statistics calls for special qualifications and high skills. Many of the present ills attributed to the lack of standards of conduct, may thus turn out to have been lack of qualified personnel.

Statistical Standards and the Census

by **MORRIS H. HANSEN**
Assistant Director for Statistical Standards
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The Bureau of the Census is perhaps the largest fact collecting agency in the world. Its popular reputation as well as its name stem from its census taking activities. Population and housing censuses are taken every ten years; business, manufacturing, and agriculture censuses are taken every five years, etc. The current statistical activities are as important as the censuses. These are illustrated by the compilation of foreign trade statistics, a monthly sample survey for measuring labor force and related population characteristics, and a monthly sample survey for estimating retail sales, current surveys of selected industries and products, an annual survey of manufactures, quarterly and annual surveys of activities of governmental units, etc. The problem of setting and maintaining statistical standards in such a multitude of surveys and censuses is not an easy one.

It is the obligation of the Census to produce results of useful accuracy on a timely basis and at minimum cost. The assertion that the results should be of useful accuracy implies that the accuracy should be measured and known, with the level of accuracy adjusted, if possible, to serve the principal purposes that the data are to serve. To obtain results more accurate than needed is as wasteful as to obtain results of unsatisfactory accuracy. To obtain results of unknown accuracy

may be grossly misleading.

The obligations which I believe an agency such as the Census should observe can be described more fully as follows:

(1) To attempt to ascertain the accuracy requirements for the data it produces. The solution to this problem is not an easy one. It involves attempting to ascertain the level of accuracy such that greater expenditure for increased accuracy would be uneconomical, in that the cost of the increased accuracy would be greater than the increase in the value of the data that result. Less expenditure with a corresponding decrease in accuracy would be uneconomical in a similar way.

(2) To use comparatively efficient methods in order to get timely results of the desired accuracy at low cost, or, if funds are not adequate to do this, to get results of maximum accuracy feasible per unit of cost. This calls for research directed towards increasing the efficiency of the methods used.

(3) To develop and present so far as feasible, objective measures of the accuracy of the results. Such measures should reflect both sampling and other sources of error. This obligation has not been widely accepted until recently, but we regard it as exceedingly important. It is not met simply by stating opinions as to the nature and magnitude of the limitations of the data. Instead, positive steps must be taken to measure objectively the accuracy of the results obtained. I must hasten to add that to obtain objective measures of accuracy is not easy. No matter how much skill, money, and time are invested in developing statistical inquiries, errors are bound to occur. A serious question arises as to how much resources should be diverted to their measurement. Careful work in this area often comes at a high price. The total expenditure needed for successfully pursuing this type of investigation may far exceed the amount that an administrator feels he should allocate to a project that would appear to do very little more than point up some of the uses that *cannot* be made of the results of a census or survey. Nevertheless, the Census recognizes the obligation for evaluating accuracy, and considerable progress has been made. I will indicate later some of the specific steps the Census has taken. The Census recognizes an obligation to provide full and frank descriptions of the survey methods and of the presumed limitations, especially since completely objective measures of accuracy are not available.

(4) A final obligation is to publish results without regard to the policies or decisions that may be affected. While the first three points I have outlined are being fully recognized comparatively recently in the Bureau of the Census, this last obligation has long been a matter of tradition and pride. The fact that the Census clearly does not represent the interest of any special group has made it easier to assure the public of its unbiased approach.

The effort to provide measures of accuracy of statistics requires that methods be devised for measuring the sources and magnitudes of such errors. Some of the more important types of errors are:

(a) *Errors in coverage.* One can conceive of a true number of residents in an area according to some definition, at a point in time. When we take a census of population, we will miss some persons and duplicate or enumerate others in error. Such errors are often larger than are commonly expected. Similarly, in an agriculture or business survey or census, there is a question of under or over-coverage. Here the problem is more difficult because of the lack of clarity of the definition of a farm or an establishment for borderline cases. Errors in applying a definition, as well as errors in location, may affect coverage.

(b) *Response errors.* A second important class of errors is errors of response. These may be accidental, or may be introduced purposely, or may arise because of lack of information. They may be introduced by the respondent or by the interviewer, or may result from the design of the questionnaire.

(c) *Compiling errors.* Errors may be introduced in the various processes involved in compilation. Compiling errors are subject to control through verification, consistency checking, etc.

(d) *Errors in classification.* The statistical classification of data, such as classifying persons by occupation, business establishments by industry, deaths by cause, illnesses by diagnosis, etc., is fundamental to many statistical operations. Some classifications are straightforward, but many systems of classification are not definitive, or are very difficult to apply, and conceptual problems and problems of the actual application of the classification system lead to misinterpretations and to error.

(e) *Sampling errors.* Errors from the use of samples instead of complete coverage are more easily controlled than the other types of error that I have mentioned. The science of sampling is developed to the point that if one follows good sampling practice, one sets the framework both for measuring sampling errors in the results and for minimizing such errors per unit of cost.

I should now like to summarize some of the activities in the Census that are designed to produce statistics of the desired accuracy and to evaluate the accuracy of the results. Some of these activities are well developed and have become established practice, even though recently, and others need considerable development.

Steps we have undertaken in connection with some of the major censuses are as follows:

(1) With each major census taken during the last decade, we have changed the emphasis in compilation from maintaining near-perfection in the compilation operations to maintaining a quality control system, ordinarily with a somewhat higher but controlled level of compilation errors. We try to balance the expenditure of resources in compiling against the accuracy of results needed, and against the accuracy achieved in the collection process itself. The necessary theory does not yet exist in useful form for measuring the contribution of compiling errors to the over-all accuracy. We have established empirically tolerable levels of error at each stage of processing, and have used sample verification methods to control the quality of results in each process to the specified tolerances. This approach has resulted in substantial economies which have been used to increase the quality of field operations where the accuracy has appeared to be at a level lower than desired.

(2) Through the introduction of sampling in the Census many items of information are collected at an acceptable level of accuracy and at considerable savings in cost.

(3) The economies achieved by (1) and (2) have made it possible to increase training, inspection, and supervision in the collection of data in the field, and also to increase the number of subjects on which information is collected. It is at this phase of the work that the ceiling on accuracy is established and where we have regarded the accuracy levels achieved as below those desired for some important items of information.

(4) We have undertaken a program of research directed toward improving the accuracy of collection methods and reducing the costs. Research has been directed at such problems as the measurement of the magnitude and sources of response errors, the accuracy and comparative cost of self-enumeration versus direct enumeration, the use of the mail and telephone as compared with other methods of collection, alternative training programs, or lack of training, and their effect upon accuracy and cost of results, etc.

(5) Finally, one of the most fundamental steps has been the introduction of a quality check of the field work, after that work is completed, as a part of each major census or sample survey. The quality checks have limitations, too, but are carried out under much better conditions than is possible for a large-scale census or survey. They provide a useful basis for evaluation of major censuses and surveys. We have carried out such checks in connection with the 1945 Census of Agriculture, the 1947 Census of Manufactures, the 1948 Census of Business, and the 1950 Censuses of Population, Agriculture, and Housing, and the current population, housing and other surveys. Some of the initial checks were on a small scale. That on the 1950 Censuses is more comprehensive and intended to provide extensive information on the nature, source, and magnitude of errors in the Censuses. We have budgeted approximately 1 percent of the cost of the 1950 Censuses, or nearly a million dollars, for this phase of the work, and we are putting a lot of our talents and resources into it.

The approach used is to carry out a very intensive job on a small-scale sample, doing all of the things we can not afford in large-scale operations such as the major censuses. The quality check on the 1950 Census provides an evaluation of completeness of coverage, and of the consistency and accuracy of response for persons, dwelling units, and farms covered in the Census. The quality check for the Population Census involved making an intensive canvass of a sample of areas in order to ferret out any people who might have been missed in the Census. It also involved a careful investigation of a sample of people enumerated in the Census to identify any duplicate enumerations (such as at both a temporary and permanent residence) or people enumerated that should not have been. Also, intensive questioning was carried out on various items covered in the Census, including age, birthplace, occupation and industry, education, income, and other items. The quality check for housing and agriculture was similar.

The quality check was carried on by experienced and carefully selected enumerators, trained and supervised much more thoroughly than is possible for the nearly 150,000 enumerators in the Census. They were paid on a daily instead of a piece-rate basis, so that they could afford to spend the time necessary to do an unusually careful job, and they were instructed to obtain the information from the person himself or the best qualified respondent in each case rather than from any responsible member of the household. In addition, the quality check includes considerable matching against independent records, including birth records, earlier censuses, social security records, etc. Internal comparisons and consistency checks also will be made as has been the usual practice.

These methods will not provide completely objective measures of accuracy of results. But they do provide objective measures of minimum levels of errors, and should provide a very much improved basis for evaluating accuracy.

The principal results of the checks will be published. These results will be useful not only to the user of census data, but also will provide the Census a basis for improving censuses and sample survey designs. I am sure you will be interested in some of the check results that have become available.

The check of the 1947 Census of Manufactures showed that establishments omitted from this Census accounted for 1.8 percent of the employment and 1.3 percent of the total wages and salaries covered in the census. Approximately 10 percent of the establishments were omitted. This latter figure is less significant than it might sound because classification of marginal cases is difficult and not unequivocal. Because of this problem the count of establishments is not very important.

Preliminary results from the check of the 1948 Census of Business show incompleteness of coverage due to failure of enumerators to list retail establishments accounting for about 1.3 percent of the 1948 sales and 0.9 percent of the November 1948 employment. Approximately 3.6 percent of all establishments were omitted. Again many of those missed were small.

Preliminary results from the check on the 1950 Census of Population shows a net omission from the census of between 1 and 1½ percent of the population. This is the difference between total omissions of a little more than 2 percent, and duplications or other over-enumerations of less than 1 percent.

The coverage in the censuses of Manufactures and Business no doubt is better than in earlier censuses, since social security records were available to control the enumeration. In the 1950 Census of Population, also, extensive steps were taken to improve training and supervision and thus to improve coverage and accuracy.

We believe, on the basis of the work we have done, that the coverage achieved in these censuses is sufficient for most needs that the Census has to serve, although greater completeness of coverage in total population counts, in particular, would be desirable, if the price were not too high. The additional costs of increasing coverage above the levels now achieved may be considerable.

Quality check results for characteristics of the population are not yet available, but errors in items such as education, income, occupation, and industry are known from earlier checking to be considerably larger than the coverage errors. These items involve some vagueness of definition and classification as well as difficulties in enumeration.

This has been a brief summary of some of the philosophy, work on evaluation of results, and the standards of presentation we try to observe. I should like, also, to consider certain criticisms that sometimes have been directed at statistical publications that I believe are not well founded.

Ordinarily, the Census publications present unrounded figures to a uniform number of decimal places throughout a table or report, without regard to the number of digits that are significant. Thus, the population of the United States is reported as 150,697,361 when it is obvious to anyone who gives any thought to it that this number could not possibly be correct to all of the 9 digits it contains. As I have suggested earlier, the last 6 of the 9 digits in the total United States population are not significant. The criticism has been made that it is a waste of space and money to print numbers beyond their significant level; and that it is a misrepresentation since it implies greater accuracy than exists.*

We have concluded that it would cost more to round these numbers to their levels of significance in publication, even if we knew how. Among the thousands of pages of tables we publish from the population census, there are few pages in which some or many of the cells do not contain numbers of three or less digits and also numbers with perhaps 4 to 9 digits. The numbers with one to three digits in the tables probably have at least one or two significant digits, whereas the larger numbers, probably have at most two or three significant digits. The units would have to be shifted from cell to cell in a table, and even in the same column of the table, to save on printing costs if each number were rounded to its significant level. I am afraid this would be most confusing. If this were not done but only significant digits were shown, then all numbers would be presented with the same number of places, even though most of the digits in the larger numbers would be zeros. There would, then, be no saving in printing but an additional cost in setting up the tables.

A more serious problem is our lack of knowledge of the number of digits that are significant in each case. The work we are doing on evaluating accuracy provides measures of accuracy for a few of the more important numbers and perhaps a rough guide to the accuracy of others. But to round all of the numbers to their assumed level of significance would be misrepresentation, since we do not have the necessary facts to do this properly. We have concluded it is better to present statements on accuracy to support the tables, rather than attempt to indicate accuracy by the digits shown.

A criticism has been made of some Census publications in recent years because of the space devoted to the description of the accuracy and limitations of the published data. The publication of data on levels of errors may have created the fallacious impression that data collected in the past are more accurate than the data collected more recently. Thus, the Census must face and continue to face increasing criticism as it spends more and more of its resources in evaluating its results. On the other hand, that such presentation of results is well-received by many careful users is indicated by the following quotation from a recent review of the publications of the 1947 Census of Manufactures:

"The frankness with which the limitations of the Census are revealed in these notes and in the richly footnoted tables should enhance, rather than diminish, the user's confidence in the statistics. Certainly, there are few large-scale compilations made anywhere else in the world which compare in scrupulousness of documentation, communicativeness, objectivity, and general quality."

* See for example, Oskar Morgenstern, *On the Accuracy of Economic Observations*, 1950, Princeton University Press.

DISCUSSION: by Clarence D. Long

It is my impression, based on extensive drudgery with data, plus an inspection of the Federal fact-finding system,[1] that no major agency strives to turn out better statistics than the Census, or opens its books with less fear of giving damaging information to its critics. Of the men responsible, moreover, for its marked improvement in recent years, Morris Hansen is, of course, outstanding. Just the same, Mr. Hansen's remarks strike me as a bit indulgent toward the past and somewhat complacent about the future.

Two of his five sources of error, sampling and compiling, are doubtless minor, in that they seem to present no difficulties that the remarkable technicians in these fields cannot eventually overcome. His others, however, coverage, classification, and response, are little understood, are probably insoluble, and do not, unfortunately, exhaust the list, for there are three additional origins of error, to be taken up as soon as I have commented on those of response.

The latter can be impressive. An example is the April 1950 labor force, for which the Census offers two estimates: one derived from its 10-year interview at all the nation's dwellings, the other from its regular monthly sample of 25,000 households. Though final results of the complete count have been delayed by the brobdingnagian task of tabulating 150 million returns,

[1] F. C. Mills and C. D. Long, *The Statistical Agencies of the Federal Government*, National Bureau of Economic Research, 1949.

tentative findings from a 150,000 sample are now available. The two surveys, since they used virtually identical labor-force questions, ought to have been apart by no more than a half million sampling error. In actual fact the estimate of the monthly sample exceeded that of the enumeration by 3.5 million, of which one in six were unemployed – incidentally, a large percentage of that magnitude – nearly three in six were employed girls and women, and the rest were employed male youths or men above middle age.

This discrepancy has been attributed to the low quality of the 130,000 temporary interviewers and their heavy responsibilities for questions on housing, income and agriculture. By contrast, the Survey staff were a "small, well trained group with, on the average, more than 12 months of specialized experience in the enumeration of the labor force . . . As was the case a decade earlier, when the monthly survey results were compared with the 1940 Decennial Census data, it appeared that the more skilled interviewers had had greater success in handling the labor force questions for population groups whose activity is difficult to measure and, in consequence, had obtained a more nearly complete count of persons who were employed or looking for work . . . Both groups of enumerators obtained practically the same results for employed males 25 years of age and over." [2]

My agreement that skillful sampling can strike closer to the mark than hit-or-miss enumeration does not keep me from being disturbed by this disparity. For one thing, it exceeds any fluctuation I have found in the peacetime labor force proportion over all the decades since 1890.[3] Second, though this was not mentioned by the Census in pointing to the excess 10 years earlier, it increased from 1 per cent of labor force in April 1940 to almost 6 per cent in April 1950, a differential at the latter date of nearly 5 per cent – roughly 3 million workers. (See footnote 4.)

Has this enlargement in the difference arisen out of an improvement in the sample Survey since 1940, or to a decline in enumeration quality, perhaps because the much higher employment in private industry in 1950 than a decade earlier made it hard to recruit, retain, and discipline an army of temporary enumerators? One hopes that the interesting tests projected by Mr. Hansen will disclose the cause of the difference and indicate what the true figure may be. But, to justify optimism, they must be much superior to the rather rough-and-ready devices used by the Census in the past, and described below in discussion of three sources of error not on Mr. Hansen's list.

The first of these is conceptual. Some magnitudes do not lend themselves to precise quantifying; unemployment is a state of mind, which might well resist the probings of a psychiatrist. Others have never been designed to do anything in particular. An example is the labor force which "just growed" before 1940 and, after a decade of drafting and experimenting, has still not been engineered for any definite purpose. Basically a compromise worked out in committees, it requires much filling in here and filing away there to fit it to the needs of economic labor supply or labor input. Yet how can the Census measure accuracy without asking "accuracy for what"? One wonders whether the attempt to do so isn't like setting up quality control for a machine when it has not been decided whether it is to sew clothes or dispense chewing gum.

A second source of error arises from timing of surveys. The decennial enumeration has shifted between early winter (as in 1920), when agriculture and construction stand at low ebb, and late spring (as in 1900), when millions of women and young people flow into summer employment. It has also varied from boom to depression, thus imperilling secular comparisons. Fortunately, all but one of the last seven censuses were taken during fair prosperity. The only one occurring at a time of mass unemployment has nevertheless involved me in a friendly debate with John Durand over whether the labor force proportion was slightly depressed in 1940 because several millions were too discouraged even to look for work, or, as he believes, because the new measurement method was more rigorous in its classification standards.

This leads me to a third origin of difficulty, the bridging of gaps between old and new concepts or techniques. I shall cite an instance and describe how it was handled by the Census.

In July 1945 the agency further modified its Current Population schedule in order, as it hoped, to define more clearly the labor force status of many working housewives, students, and unemployed.

What was the new schedule's effect? This was not easy to ascertain, for the labor force ordinarily fluctuates seasonally and was then also vulnerable to impending cutbacks in war production and employment. The Census, besides the pretest it had conducted in April 1945, made a double poll in the initial month of July, interviewing identical households with both old and new schedules.

In general, its new method of questioning appeared to increase each subgroup of the "employed" and "actively seeking work" and to decrease the "inactive unemployed" and "not in the labor force." Using overlap ratios in various age and sex groups, supplemented with the April pretest and "evidence of other studies," the Census revised its employment and unemployment estimates of each month back to 1940, raising the labor-force estimate for March 30 of that first year by 1.5 million and, since the previous estimate had already been 0.5 million above the complete count, causing the revised estimate now to exceed it by 2 million. Some of the intervening monthly estimates were raised by substantially greater amounts.[4]

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[2] 1950 Census of Population, Preliminary Reports, Series PC7, No. 2, p. 1.

[3] C. D. Long, *Labor Force, Income and Employment* (mimeographed manuscript, National Bureau of Economic Research, 1950, now being revised).

[4] Current Population Reports. *Labor Force, Employment and Unemployment in the United States, 1940 to 1946*, Series P-50, No. 2, pp. 5-6, 9, Tables III-IV. The previous figure was itself a revision of the original estimate of the Work Projects Administration (Bureau of the Census, *The Labor Force Bulletin*, November 1944, pp. 5-8, 10). The original WPA estimate, for which the Census assumes no responsibility, was 1.4 million above the 1940 Census count, though it may have been for mid-April rather than the last week of March, the date to which the Census referred. Oddly enough, the results were much closer in 1940, despite the fact that the wording of the WPA schedule differed somewhat from the Census enumeration schedule.

These amendments for 1940-1945 should not be allowed to escape criticism. First, July 1945 could hardly have been a worse month in which to stage a test survey, for the armed forces contained a dozen million men; unemployment was less than a million; and the civilian labor force was distorted a long way from its usual age, sex, and industry composition. Tests for such an unusual time could not easily apply to months or years when as few as a million and a third were in military camps; when as many as 8 million were idle; and when the occupational and demographic structure of the civilian labor force were more normal, or were abnormal in a different direction. Second, the overlap ratios rested upon 25,000 households divided into 364 subgroups. Since some of the cells doubtless contained no more than a few score families,[5] they must have yielded errors that were enormous; e.g., unemployment.

There is no charitable name for using a small sample, based on one month, to correct data covering sixty months and a full range of seasonal, cyclical, and war and peace variations — not even when it has been reinforced in some undescribed way by a pretest of unstated size and by "other evidence." The remark that the "figures were not necessarily reliable enough to justify separate publication in complete detail" is a landmark among understatements.[6]

Instead of attempting to reconcile in this manner a series costing nearly a million dollars annually, the sensible course would have been (a) to postpone the new schedule to a less hectic time — after all, Germany had fallen two months before — and (b) to spread several double enumerations over a few years, taking care to represent adequately the various parts of the year and stages of economic fluctuation. This case does not stand alone. No more in keeping with Census standards was a special downward adjustment, to the new measurement technique instituted in 1940, of one and a fifth million persons not occupied or seeking work in April 1930, who were supposed to have been included by the Census on the mere basis of their presumed work experience at some other season of the year; e.g., the previous summer's harvest.[7] After all was said and done, the only objective basis of this adjustment turned out to be a study of original schedules so informal that it was never tabulated or written up so as to be available for inspection. Further details on these two matters will appear in an appendix to my forthcoming book.[8] One can only impute such horseback adjustments to lack of funds, and hope for a sharp improvement in the devices by which transitions to new techniques are made. But however made, they will always involve difficulty and danger. Thoughtful statisticians will recognize that, even if there were a Platonian ideal, the approach to it would be slow, but that in actual fact the goal is not stationary, for as techniques of measuring a thing improve, the thing itself evolves in performance, quality, value, and even name.

Conclusions

My conclusions do not inspire joy. High scientific accuracy will require the government to spend many times the present relative pittance devoted to data collection. (I was going to say peanuts, but the value of an annual crop of that vegetable turns out to be worth four times the 42 millions Mills and I found to have been the Federal outlay on statistics in 1948.) [9] It will also necessitate placing the data on a sound analytical basis. If too much counting and not enough cogitating take place in Washington, this state of affairs is the fault partly of Congress, which has never been anxious to pay for theoretical work in the social sciences, and partly of the bureaus, which have always felt safer behind charts of statistics however uncertain their meaning and purpose.

A supreme order of exactness will hardly arrive in my time. Economic data can be improved to serve market research and broad aggregation, where the purposes are understanding, perspective, or crude quantitative reference. I, personally, am a little doubtful that they can ever be machined for use in linear programming, involving dozens and eventually scores, hundreds, or thousands of equations, where precise results are needed.[10] After all, statistical agencies get such data from people, who, both as individuals and as organizations, exhibit a variety of purposes, possess many motives for under- or over-stating and concealing, and do not live and think in milligrams and micrometers.

There is no need to close on an entire note of gloom. Life can go on with less than perfect statistics; and, if perfection can never be attained, consider the progress since the 1840 census, which shocked the newly organized American Statistical Association into joining in the following memorial to Congress:

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[5] This is pure conjecture, since the Census does not, regrettably, publish the number of households reporting in these various cells.

[6] Current Population Reports, *Labor Force Bulletin*, Series P-50, No. 2, p. 6.

[7] Sixteenth Census (1940), Comparative Occupation Statistics for the United States, 1870-1940. Chapter IV, especially the adjustment for seasonal workers, pp. 13-14.

[8] *Op. cit.*, Appendix C. See reference there to similar misgivings of the late Daniel Carson, in an unpublished manuscript sent to me several years before his death.

[9] *Op cit.*, p. 187.

[10] I should like to put this question to the mathematicians: What is the likelihood that small errors in basic data may "pile up" in highly complicated problems to very large errors in relation to the final result? In my own brief survey of the literature I have not seen an encouraging answer, though there may well be one, provided errors are random. (Oskar Morgenstern, *On the Accuracy of Economic Observations*, Princeton University Press, 1950, pp. 39-44. J. Von Neumann and H. H. Goldstine, "Numerical Inverting of Matrices of High Order," *Bulletin of the American Mathematical Society*, 53: 1021-99 (1947), especially pp. 1024, 1028-29. *Proceedings of a Symposium on Large-Scale Digital Calculating Machinery*, Harvard University Press, 1948, especially W. W. Leontief, "Computational Problems Arising in Connection with Economic Analysis of Interindustrial Relationships," pp. 169-75.) But errors can never become wholly random in economic data, which can only improve as a result of more highly organized government and industry and yet are likely to be biased by the taxation, expenditure, and regulatory pressures on people brought about by this organization. Worse, most economic observations do not stand alone. For example, errors in labor force data may infiltrate production and income data and perhaps contaminate a large part of the input-output table even before a single computation has been made.

". . . in returning the people according to their several employments, some of the marshals 'seem to have included the whole population, men, women and children, in these classes, arranging them, probably, according to the employment of the head of the family, and some seem to have noticed only the males over 21 years of age; others seem to have noticed all who were sufficiently able to perform any service; and, lastly, some seem to have entirely neglected this duty, and have recorded none in some of the employments; and in many counties none are reported to have any employment whatever'." [11]

For example, Detroit, with 9 thousand people, returned in that year only 25 workers: 22 in manufacturing, 1 in commerce, and 2 in the learned professions (not counting 6 persons occupied "for revolutionary or military purposes").[12] The past 110 years have brought advances in Census standards that I wish could be extrapolated into the future. But there is very likely a declining rate of growth in the accuracy of statistics, just as in many of the magnitudes they purport to measure.

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[11] Carrol D. Wright and William C. Hunt, *The History and Growth of the United States Census*, Senate Doc. 194, 56th Cong., 1st Session, 1899-1900, G.P.O., Washington, p. 37.

[12] *Compendium of the Enumeration of the Inhabitants and Statistics of the United States, as obtained from the Returns of the Sixth Census, 1840*, p. 95.

DISCUSSION

I welcome Mr. Long's comments because such discussion may stimulate more widespread consideration of the possible accuracy of statistical results and the accuracy requirements on data. As an experienced analyst of Census data, Mr. Long is particularly well-fitted to speak about the problems he has discussed. However, his comments have been limited primarily to calling attention to the existence and magnitudes of certain discrepancies between labor force aggregates as measured in the censuses and in current estimates that already have been described and discussed openly and in considerable detail in the publications of the Bureau of the Census. They are well known to a large number of labor-force technicians and others, including many of those who lean heavily upon those data for economic analyses and policy determination. Moreover, in my judgment the way comparisons are made in Mr. Long's forceful presentation has the effect of exaggerating some of the differences and problems.

I am concerned that Mr. Long seems to interpret as an indication of complacency the fact that the Census openly cites discrepancies in its results without the same horror they seem to hold for him. We do regard them with concern, and have gone to great lengths to measure and analyze such differences. We believe that an essential step in arriving at the appropriate levels of accuracy to be required in statistics is to measure the errors involved, and that the public will not be misled if such measures are made freely available along with the results. We believe this represents, not complacency, but the primary step essential to dealing with the problem of improving methods of balancing accuracy and costs in the collection of data.

Pointing up the discrepancies in the striking manner of Mr. Long's discussion raises a number of questions for which he does not suggest the action to be taken. Is his conclusion that data to be useful must be free of error? Is his conclusion that if two series disagree that one or both of them should be suppressed? Does he believe that procedures should never be improved or concepts modernized if apparent continuity of Census data is broken? Does he argue that it would be justified to double or triple the already large costs of a Census, if necessary, in order that it provide national measures as accurate (assuming this to be possible) as are already available from a small carefully designed and administered sample survey? I am sure he recognizes that complete Censuses may provide local area data of much greater accuracy than would a small sample and at the same time provide less accurate national data, and that this fact, together with the need for timely national data, may call for the use of both approaches.

A discrepancy in published figures is important only when it invalidates the primary uses for which the data were collected. Users of Census data can do a great service by pointing up what uses the data at various levels of accuracy will and will not serve. Mr. Long's remarks may help to precipitate further discussion and suggestions. Such remarks and suggestions are not only welcome but needed if statistical agencies are to meet adequately their obligations to the public.

MORRIS H. HANSEN

REJOINDER

A rejoinder should be short—and, of course, sweet. Let me ask a half-dozen questions.

1. If Mr. Hansen cannot extract a little horror from a discrepancy of 3.5 million, 6 percent, between two surveys that were made on the same date, used the same questions, and undertook to measure the same magnitude, is he not indeed "a bit indulgent toward the past and somewhat complacent about the future"?
2. Is the picture really so bleak that it would cost $100 or $200 million extra to conduct censuses and sample surveys in such a way that they agree? As one constructive suggestion, how about getting a better grade of census interviewers and paying them by the hour rather than by the

name? As another, why not stop the pernicious practice of enumerators getting their information from neighbors and landladies?

3. Where in its literature does the Census recognize that this gap between census and sample surveys increased from 1.0 percent in 1940, when the WPA conducted the sample survey (see my footnote 4), to 6.0 percent in 1950, when the Census managed both of them?
4. What labor-force technician has ever indicated in print his awareness of (a) the above increase in discrepancy over the last decade; (b) the almost complete absence of formal support for the so-called seasonal-worker adjustment of the 1930 census; or (c) the readjustment of 60 months of labor force data during 1940-45 on the basis almost entirely of one sample survey taken in the midst of an emergency?
5. Granted that no time is ever normal, should concepts be changed suddenly in the midst of great wars? In fact, should they be changed at any time, if the census can't afford to spend enough to reveal the effect of the change with reasonable care?
6. Does the Assistant Director of the Census really disagree with my main point, that statistical standards in his Bureau need improvement, despite the fact that it is one of the most conscientious of the major statistical agencies?

CLARENCE D. LONG

"The Statistician and His Conscience"

by THEODORE H. BROWN

The questionnaire for the fortieth reunion of my college class included a request for "political affiliation." The class book reports that my answer was "Reactionary Republican." The word reactionary is understood to mean that I still believe in arithmetic and that one can't spend more than he has without getting into debt. The only road to wealth is to produce more than you consume." This evidence in the present national atmosphere obviously makes me unqualified to bring a liberal point of view to bear on the assigned topic. In addition, because I did not submit this particular statistic to the program chairman prior to acceptance of the present task, I omitted some pertinent information which he should have had before him. I am therefore ethically in the wrong. Having demonstrated that I am unfit to discuss the problem, let's look at it.

It is, of course, unwise to judge a particular question detached from its setting. The conditions which surround the misuse of data, including the influences which motivate people and the services which data perform, must be understood. Without such a diagnosis, any prescription would be a careless guess. A statistician's conscience probably will not be soothed without knowing what besets him. The setting and a partial diagnosis, consequently, will be undertaken first.

Attitude of Mankind Toward Numbers

From time immemorial, men have hated numbers. In fact, numbers have often been assumed to be a part of the exclusive bailiwick of Beelzebub. In the book of Chronicles we read, "And Satan stood up against Israel and provoked David to number Israel and David said to Joab and to the rulers of the people, 'Go number Israel from Beersheba even unto Dan and bring the number of them to me that I may know it.'" The story goes on to indicate that some of the tribes were omitted so that the final count was not correct. Let me hasten to add that this ancient pattern is not the model followed by our Bureau of the Census, although in a parallel enumeration of tax returns, some seem to have been passed over.

If these hates are real, universal, and significant, the statistician may face a much more serious job than he bargained for in an attempt to raise standards. Perhaps the cause of such attitudes is that numbers threaten personal security.

One may hazard the guess that people feel insecure in part because of the precision of numbers. Most of us prefer to work and to think in terms of generalities rather than in terms of exact values. One might almost divide the world into two parts, in one of which there exists the distasteful events of monthly bills, the purchase of an exact number of quarts of milk or gallons of gasoline, and in the other there exists the world of relationships among people in which precision often means little. In the world of precision where one is called to an exact accounting, the individual may be on the defensive. This is a state to be avoided. Thus, the car owner proves his right to security when he drives into the gas station and says "Fill 'er up." He enjoys his superior freedom, since the pump must struggle with the gallonage measure and with the computation of the amount due. Here our unpleasant arithmetic is mechanized even to the extent of a periodic clang of a bell by which the mechanical slave reports to his important master.

In another case, a workman who was earning much more than an average wage might be judged to have been entirely reasonable in the purchase of a number of household articles through time payments. The

television, the refrigerator, the automobile, and other things, each considered in its own right, was fully justified in terms of the good job which he held. Unfortunately, his promised weekly payments exactly computed by the precise, but unpleasant, job of addition, totaled more than his weekly wage.

The unhappiness of many in connection with numbers often has its origin in the early grades of school. The rigidities of arithmetic bring the pupil daily under the necessity of facing an exact requirement. Examples are either right or they are wrong. One small boy covered his unhappiness by reporting at home that he had done nine examples in long division and that they were all correct but the answers.

To make the matter worse, numbers may be used with varying amounts of exactness. This leads to more confusion, uncertainty, and insecurity. Johnny knows that he has 6 cents in his pocket. To him this is important, appropriate, and an exact condition. Johnny's father, however, who also has exactly 6 cents in his pocket, may make the comment that he has no change. To Johnny the 6 cents in terms of candy, tops, or marbles represents a precise, thoroughly appraised amount of wealth. To his father, who needs change for a tip, the same sum is an indefinite, insufficient amount of coin.

Another trouble which besets people in regard to numbers is that these same numbers possess certain seemingly mystic properties. Many cases are well known. Thus, the sum of odd numbers beginning with one is always a perfect square. The square root of that perfect square is exactly the same as the total count of the odd numbers which have been added together. Other examples include magic squares or games such as chess or bridge.

To make matters worse, when numbers become entangled in some procedure such as those which are familiar to the statistician, the results, and hence their meaning, often become even more mysterious. And so again, people tend to shy away from the insecure unknown.

Presumably, these insecurities should trouble the statistician only by reflection on his conscience. In such fields as statistical quality control, data provide a source of factual evidence on which technicians can build the security needed for a broad range of problems. Mention also has been made of the quality of data compiled by the Bureau of the Census, on which so many of us depend. Since many examples of high quality are familiar the discussion has been directed toward the infrequently recognized and unhappy way in which much of mankind looks upon numbers. The statistical weather appears to be only partly cloudy. Most men will perhaps agree that figures of one kind are wonderful, but even here, wrapping them in mink coats does not necessarily bring security.

Objectives of Numerical Facts

Statistics may be defined as facts in numerical form, or the numerical results of analysis. Because numbers and mathematics can be abstract, people often tend to look upon statistics in this light. There is present, therefore, the danger that the individual will forget that numbers can represent concrete things or a statement of a definitely known condition. Since statistics represent the concrete, it follows that the use of statistics must always be made with reference to those things or conditions to which they apply. This is the condition of safety for the valid use of numerical fact. Situations in which there is failure to observe this condition of safety may indeed cause trouble for the statistician's conscience.

Whenever someone refers data to a basic area which is not that for which the statistics were compiled, he may find himself possessed of conclusions which appear to validate a situation entirely different from that which the numbers really picture. To determine whether there has been a shift in objective, one should be able to write in a single simple sentence the exact objective desired for either or both cases. The results should agree. If this cannot be done, there is need to return to a fundamental study of the subject.

An illustration of a shift in basic point of view is to be found in the Price Index of the Bureau of Labor Statistics. In the language of the man in the street, this Index usually is referred to as a cost-of-living index. Nevertheless, one is utterly unable to write a definition of a cost of living which is acceptable to all points of view. Without a definition, a cost of living is meaningless. Is this index intended to reflect the cost of food, shelter, and clothing which will provide a minimum condition of living so that a man may not die? This is not wholly determinable, since some men will perish under less austerity than others. Moreover, most wage earners will deny this minimum is acceptable, since many of them are coming to believe that an automobile, a radio, a television set, not to say a refrigerator and a washing machine, should be included as necessities in a minimum cost of living. They go even further and declare that their relatively small taxes should also be included. Maybe we should achieve complacency by writing off appalling Government waste as a necessity of life. By contrast, a price index can be defined to include certain commodities sold at retail. These will bound the index and define the price area. Whether they represent everything which the greedy think should be included for the index is quite another matter. It is cases like these that cause the statistician's conscience to jump.

This same difficulty is used as a device to produce a predetermined answer. Whether it is done thoughtlessly or deliberately, the statistical results are open to question and are those which should trouble the statistician more than they sometimes do. Thus, it is notable that politicians and lawyers seem to decide first what conclusions are to be reached and then hunt for numbers which appear to carry the same label as the given situation. Data misused for this purpose are not evidence; they are irrelevant nonsense. This slick approach may seem desirable to some, but it has no place among men who seek the truth.

To show that the objective and the statistical work may be correlated and correct but deceitful, we might extend the index-number illustration. Hearsay reports that a division in a university supported by public funds made an investigation and as a result found that what they called the cost of living was going down. The public authorities who had to vote the funds for the support of that institution happened on a copy of the report and immediately concluded to cut appropriations. Whereupon, the same eager people shook the dice box once more and found that

although the previous report was absolutely correct, the cost of living for members of the faculty of that institution of higher learning was going up at an appalling rate. This may sound like a group of individuals engaging in double talk, but both compilations could have been justified if one is permitted the simple device of making two definitions of cost of living, one for each of the two groups involved. People, of course, in cases like this blame the number work because that is the part they do not understand. In the armed services a case of this sort is called the "numbers racket," but its cure is in recognizing differences in definitions, not in understanding some difficult computations.

This failure to know that statistics must be related to objectives is one which is continually happening throughout the human world in which we live. The statistician's conscience presumably should view this problem with understanding, but not necessarily in violent rebellion. I doubt whether this disease can be cured, but at least we can continue to teach a way toward better statistical health.

Communication

Within the area of communication, statistics provide a kind of shorthand by which a very large amount of information can be compressed into a small space. Thus, in 1759 John Graunt reported that among many causes of death in England in 1728, thirteen died from lethargy. Only a total was wanted for a given year. Identifying these was most simply done by two numbers. Other descriptive methods were possible but much longer. If the matter is looked at not from the point of view of the compiler but from the point of view of the user, either of two situations are present: data may be compiled for general public use or for use within a limited group such as a given business. Each will be considered in turn.

One of the charges made against data compiled for public use is that of hasty work. At times, undoubtedly, this charge could be supported. Yet it would seem as though it was mixed with other problems. What appears to be hasty work may be incomplete work because of the difficulties found in the job of collecting the material. For example, suppose that it is desired to obtain the sales figures for the retail stores of a moderate-sized town. If a total is not wanted, the first thought is to classify the stores by groups, carefully defining the character of the stores within each group. Even here there are difficulties. Assuming that these difficulties have also been surmounted, there may be the ultimate one of refusal on the part of the chain stores, for example, to contribute the sales figures for the units in this particular town. If at any step along the line of collection of the data there is a serious block, the data are incomplete. To the outsider, the totals may appear to be the result of hasty work, and yet this is not so. The compiler possibly was slow in securing all the figures or possibly some store did not compile the requested information.

Since the middle 1920's there has been an enormous increase in the volume of statistical data which has been made available to the general public. Could it be true that living in a wealth of statistical data it is inevitable that some series would not be of top quality? Since data in business are used as a basis for decisions, the businessman might find useful rough approximations to ideas he seeks out of imperfect material. One wonders also whether the natural irritation of a statistician does not occur because he fails to find exactly the series of data which he is seeking.

The statements which have just been made were written with the thought of observational data in hand. Whenever the numerical values are the result of a sampling process, additional care must be taken, since the design of the sample often will make the difference between usable data and those which are of very doubtful quality.

Finally, there is the problem of pressure on public officials to produce figures which seem to support a desired political position. Great credit is due to those who have refused to permit a compromise with high standard for political purposes. Cases where men have resigned rather than compromise have been reported in newspapers even within the last few years. One rejects with scorn interpretations of facts which have come from high places and which are obviously designed to protect and support those who are in political power and to deceive those who do not know how to discover the fraud which is present in the publicized figures.

Whenever the problem is that of communication within a given business and for private uses only, the same fundamental premises of care, completeness of data, and thoughtful reporting are also necessary. The pressures within a company which the statistician believes force him to support a predetermined position are not unknown. As it is presumed that he must live with his conscience, as well as with his associates and bosses, the possibility of an inward conflict is created. This is the additional element of primary importance in the handling of statistical problems within a company in contrast to the use of public data. Sometimes differences in opinion are justified. It must be realized that colleagues can be right. No matter whether different objectives, lack of mutual understanding, or just plain lack of knowledge is involved, the lines of communication are jammed. The only reasonable approach here is to get the various parties together in a huddle and then to work out some basis of common knowledge.

No doubt there are determined individuals who want only to give commands, but in the long run some way usually can be found to reach an understanding with them. The statistician thus needs to know something of the art of getting others to listen at least half heartedly. After the first thirty seconds, he should be able to warm them up fast, not in antagonism, but in support. Perhaps this is why so many business statisticians in high places are more than mere technicians. They are very real people with whom it is a delight to discuss problems.

Of course, difficulties arise, such as when a report has been compiled for internal use and then the boss incorrectly uses excerpts in a speech. Foresight here will help, but no one can control information put in the hands of others. Ben Franklin is said to have remarked, "Three people can keep a secret if two of them are dead."

The Statistician's Bailiwick

We have looked at the world of the statistician in which he and his conscience dwell. Obviously, he must dwell in a country which is far from perfect.

It is a place where people naturally dislike numbers, a community where they fail to understand or deliberately misuse the necessity of associating numbers with objectives sought, or a land where statistics are used as a shorthand means of communicating facts which would otherwise require many pages of wordy description. Mixed with the intentions on the part of the compilers of statistics are the pressures of public and private individuals who insist that data shall serve careless or selfish interests. These are all parts of the environment within which the statistician has to live. In the techniques of his own shop, he should be strict with arithmetic and analysis but flexible in strategy of plan. Two illustrations will identify the problem.

Some men like graphs while some want tables, claiming that they do not understand graphs. Even after this decision is made, there are needed many decisions of style. In one large company where many different executives use graphs, there are many differences in regard to style which one or another executive demands. Three people are involved here — the executive, the statistician, and the statistician's conscience. The last can be eliminated by a knowledge of the variety possible in technique and a sympathetic understanding of what people want.

For some trend problems the best trend line is one which has been drawn in by eye. Presumably the technician would have, at least, considered the mathematical fit of some equation, but he need not insist upon it as the only proper method. Some will say that the fit by eye is fraudulent. Again, three possibilities are present, and one or more of them may be true. Either the statistician does not really understand the range of his technique, or he does not understand what the business problem requires, or he needs a new conscience.

No one should suppose that I am advocating the abolition of conscience. I am simply trying to say that for the statistician, the world is a very human one in which conscience should be a guide for a free man, not a jail turnkey.

Whenever data from outside sources are used, the product and the compiling agency itself must be reviewed quite critically. The reason is obvious. One cannot check the details of computation. Much less can one check the preliminary definitions and the preliminary work which are involved. Some elements in the situation, however, can be checked. As an illustration, turn once more to the making of index numbers. Answers to the following questions are pertinent.

Design Objective—What is the maker trying to accomplish?

1. Write an exact definition of the design objectives.
2. What is the base period? Does the base period affect the design objective?
3. Is the index a general purpose or a special purpose summary?
4. Is the index compiled for public use or for the use of one business?
5. Is the index constructed for evidence or to "prove" a point?

The Index Number Maker — Who prepared the index numbers?

1. What individual and/or organization constructed the index?
2. Have they a direct or an indirect partisan interest in the results?
3. What rating can you give this maker in regard to integrity or skill as reflected by work done in the past?

Construction Methods — How was it done?

1. What commodities or articles were chosen?
2. Can these be judged as meeting design objectives?
3. If original data are used, do sampling points meet the design objectives? Is the sampling plan likely to give reliable results?
4. If data were taken from others, do they fit into the design?
5. Does the technical method used for combining figures satisfy the design objectives?

Now let us look at the problem of what to do. It is suggested by some that the way around all of these difficulties is to follow the pattern of the medical profession and require a Hippocratic oath. Notwithstanding this, one finds from time to time a physician who is unworthy of trust. Moreover, there are inevitably misjudgments in spite of the infinite pains which our doctors take caring for our physical welfare. It does not seem that for statisticians such an oath would work for a very simple reason. People want to get well, while in statistics, some want to do poor or fraudulent work. For the doctor, the problem is largely up to himself, while the other party to the contract is impatiently waiting, but for the statistician, there is himself and quite likely an indifferent or hostile client.

A second proposal is that for a code of ethics, which presumably every statistician should accept as a set of standards of conduct of pharisaic character. It seems that this also is faulty because the statistician quickly obtains through such a code a set of rules by which he is presumably able to measure the quality of himself and of others. I do not know of anyone who is wise enough to assume such responsibilities. Judgments which have to be made in regard to the infractions of laws can be difficult enough. A judgment of the motives or the intents of fellow beings becomes even more complex. This type of code seems unwise, for it will either be forgotten, go unobserved, or will serve to narrow the habits of the statistician to a rigid conformity. If this last condition should happen, the statistician's value is gone.

There is one model to which mankind over a period of more than two thousand years has turned for help in problems of this sort. It is the Bible wherein broad goals are set toward which men can strive. Here one finds, not a set of rules to govern each and every variation in the continually changing pattern of life, but a few general commands and many hints to show how men can live in peace with their fellows. I do not recall any statements in the Bible about automobiles, telephones, or TV sets, but I am sure I can find some ideals which apply to the courtesy of the road or to gossip or to excess in amusement. It is a code in the sense of ideals which holds the promise of help.

I plead guilty to plenty of nerve in suggesting items for such a code, but I accepted the job of this paper

and this is the way I see the only hope of solution. In writing down some ideals, I am convinced that they will not bring the millennium nor will they cure the difficulties of having bad statistics and poor statisticians. The hope, rather, is to set a pattern of life which will bring, first, some leadership, then imitation, and finally, a better way of statistical living.

Some ideals:

1. A burning desire to find the truth. For unless one is thus deeply stirred, he will never measure up to the full stature of his calling.
2. Thorough care to understand completely the work of others. For communication depends upon understanding of both the assumptions and the methods by which statistical results are derived.
3. A constant effort to present clearly the work of my hands. For communication of valued information warrants thought to make understanding perfect.
4. A diligent search to develop evidence bearing on an hypothesis rather than on a predetermined conclusion. The freedom of man depends upon evidence in regard to a problem rather than on what may be discovered about it.
5. The wise use of methods to produce the best results from the analysis in relation to the problem in hand. For with a choice of procedures the analyst seeks to build an honest security of those he serves in the most effective way.
6. The willingness to answer reasonable requests about the details of statistical work if such request is honestly justified.

Many hundred years ago a prophet set an ideal in the form of a question which has stood as a pattern for the deeds of men. "What doth the Lord require of thee but to do justly and to love mercy and to walk humbly with thy God?" I have tried to spell out some details of this plan of life as they seem to apply to the kind of work we do. And I am persuaded that if we set goals beyond our present habits, we thereby set the manner through which our level of accomplishment can be raised and the quality of our work kept high.

DISCUSSION: William W. K. Freeman

Some people do things the easy way, while others do them the hard way – like the Arabs new to Western methods who filled a wheelbarrow with concrete and then hoisted it to their shoulders to carry it to the form.

The easy way for me to show my agreement with the main thought of Mr. Brown's paper, would be to imitate that Member of Parliament who gave enthusiastic approval to a speech of Edmund Burke by shouting, "I say ditto to Mr. Burke!" But I shall do it the hard way, by examining with you some of Mr. Brown's words on a code of ethics briefly and trying to develop their meaning more fully.

Certainly I would agree with him in thinking that a code of ethics is not the solution to dishonest statistics if I believed that a code would necessarily and inevitably turn all of us who read it into little tin gods. It appears to me, however, that the statement of the six ideals which he has suggested for us to live by, have in fact the characteristics of a code of ethics, in the sense of a target, a goal, an inspiration, a reminder of standards to follow, which should provide leadership, as he says, towards "a better way of statistical living."

Mr. Brown is right in pointing out the danger of our becoming Pharisees, however, and along with ideals which he has expressed for us is his injunction "to walk humbly" – a very good reminder especially to any one trying to formulate a code.

Perhaps in speaking of codes, we should clarify our meaning, for as Locke says, "Let us look into Books of Controversy of any kind, there we shall see, that the effect of obscure, unstedy or equivocal Terms is nothing but noise and wrangling about Sounds, without convincing or bettering a Man's Understanding. For if the *Idea* be not agreed on, betwixt the Speaker and Hearer, for which the Words stand, the Argument is not about Things, but Names."

It appears to me that some people associate the word "code" with a set of pronouncements legally enforceable. While it is true that some codes have the force of law, that is not true of the Code of Professional Practice developed by investment counselors, for example, nor for such commonly accepted ideas as codes of sportsmanship or codes of honor. Ours is a comparatively new profession, of all degrees of complexity in its technical aspects and all degrees of responsibility in its members. Discipline is either impossible or at least is in the distant future when Mr. Brown's statement of ideals and those of many other members shall have been hammered into a shape which has gained acceptance.

Codes of ethics vary in elaborateness all the way from the six-sentence code of Investment Counselors to the 50-page double-column code being developed by the American Psychological Association. In each of seven fields the psychologists have prepared a statement of problems, brief case histories which are labeled by the committee developing the code as ethical or unethical, and a statement of a principle to match each problem.

Here in Boston we have been gathering ideas too – but *un*officially and *very* informally. In connection with the paper I presented at the fall meeting of the Boston Chapter on "Integrity and Diplomacy in Statistics," I became interested in codes, or ideals, or statements of principles, or standards of conduct, or whatever you want to call them. I found that the development – "eventually" – of a code of ethical

practices for the American Statistical Association, was recommended by the 1949 Committee on Committees to be the responsibility of the newly created Commission on Statistical Standards and Organization. Since the Commission had not yet begun this laborious task, the thought occurred to me that it is easier for an executive to work over the ideas of subordinates offered for criticism than it is to start *de novo;* and as they say in the Marines, "What are we waiting for?" After all, this Association was founded here in Boston, and ideas should sprout as plentifully here per capita as in Washington or New York, where they may later be cultivated to produce fruit to be marketed by those who have that responsibility.

Consulting with other members of the Boston Chapter, I arranged a series of small luncheon meetings of statisticians both within and without the Association, providing them beforehand with the latest draft of ideas to be worked over and extended. Draft No. 8 is available today, the cumulative product of about 55 people in this and other cities; for some of the kindly people I have met at conventions were good enough to take the time to write me their criticisms. I feel sure the Commission on Statistical Standards would value some expression of opinions in this meeting as to whether a code should be a very brief statement of guiding ideals as stated by Mr. Brown or a detailed case-history type of code like that of the American Psychological Association, or something in between.

Let us now consider how a statistician can live up to his ideals. Mr. Brown has spoken of the client who is indifferent or hostile to the statistician's struggles to follow the dictates of his conscience. "Ay, there's the rub." The problem of dishonest figures involves not only the statistician who believes he is required by the profit system to "shade" the figures he presents to a state board, and the statistician who conceives it as honorable to "make a case" for his employer; but also the statistician who is determined to maintain his integrity under pressure for biased statistics.

Here we find the necessity for statisticians to train themselves to be "wise as serpents and harmless as doves." For statistics to be practiced as an honorable profession, a man needs to study psychology, salesmanship, biography, and the Book from which Mr. Brown quotes the injunction to "walk humbly."

Let us see what Benjamin Franklin has to say (in part) on Humility.

"My list of virtues contain'd at first but twelve; but a Quaker friend having kindly informed me that I was generally thought proud; . . . I determined endeavoring to cure myself, if I could, of this vice or folly among the rest . . .

"I cannot boast of much success in acquiring the *reality* of this virtue, but I had a good deal with regard to the *appearance* of it. I made it a rule to forbear all direct contradiction to the sentiments of others, and all positive assertion of my own . . . When another asserted something that I thought in error, I deny'd myself the pleasure of contradicting him abruptly, and of showing him immediately some absurdity in his proposition; and in answering I began by observing that in certain cases or circumstances his opinion would be right, but in the present case there *appear'd* or *seem'd* to be some difference, etc. . . .

"And this mode, which I at first put on with some violence to natural inclination, became at length so easy, and so habitual with me, that perhaps for these fifty years past no one has ever heard a dogmatical expression escape me. And to this habit (after my character of integrity) I think it principally owing that I had early so much weight with my fellow-citizens . . ."

The means by which a statistician can maintain his integrity and still keep his job have been discussed in the paper to which I referred on "Integrity and Diplomacy in Statistics" in which 6 case-histories were given of success under pressure for biased statistics.

In discussing these problems with statisticians, I have got the feeling that too many business statisticians say, "Yes, Sir" — perhaps to some extent because they have not acquired the skill in salesmanship and diplomacy to do otherwise and still hold their jobs.

It was with the idea of fortifying the position of the honest statistician in the sight of his client, that I suggested the need for something dramatic, like the Oath of Hippocrates, unaware of the fact that others had preceded me with this idea. Harking back to the impressive scroll which I saw hanging in a doctor's waiting room, not only to serve as a reminder to himself but also to inspire confidence in his patients, the thought occurred to me that statisticians might be invited to subscribe to a Statistician's Oath and be furnished by the Association with a similarly impressive scroll.

It has been suggested that instead of calling such a statement an oath, it would be accepted more widely if it were called "The Statistician's Principles;" but whether it is an oath or a statement of principles, I am not at all satisfied with the idea, for it borders on the "pharasaic character" against which Mr. Brown warns us. Such a document, however, may have some little value because we need to persuade some clients and employers that a statistician has, in Mr. Brown's words, "a burning desire to find the truth" and that his skill is not to be purchased "to develop evidence bearing . . . on a predetermined conclusion."

At any rate, regardless of its merits, or lack of them, so that this audience may know what we are talking about, let me present it for discussion. Some one may find here some seed worth cultivating.

THE STATISTICIAN'S PRINCIPLES

Like Euclid and all the other great thinkers who have used symbols to reveal the truths of nature, I will be a seeker of the truth.

Realizing that numbers are only a shorthand convention for describing past events and forecasting trends, I will search for those facts expressed in numbers which show relationships and events most truly.

Though surrounded by the clamor of the market place or of the political arena, I will not be a fraud, who selects figures to prove by chicanery a misnamed conclusion.

The main questions for discussion, however, are whether *any* form of document is worth developing for framing and developing, and then what form is likely to have the maximum effect on the Statistician and on his employer or client. These ideas have been

gathered unofficially from members of the American Statistical Association, but there is no thought of empowering a professional committee to enforce discipline. The statements are ideals rather than legal requirements and are meant to provide for statisticians of all degrees of responsibility, a moral force to support their integrity.

The code goes beyond any legal liability and transcends the master-and-servant legal relationship of the employer and the person who prepares figures at his direction. It attempts to set an ideal in harmony with ultimate truth and makes some suggestions on the means by which individuals may bring unfavorable outside forces into harmony with their personal intellectual honesty.

Some specific provisions which have been suggested are as follows:

1. A statistician seeks to express the truth in figures. He searches for figures which show relationships most truly, within the limits imposed on him by time and economy. He does not design an experiment to yield biased results; for example, he does not offer in a survey 3 designedly inferior types of a product and one good one and draw conclusions from the response. When the figures available do not, in his best judgment, represent the facts, he gives proper warning of their limitations.
2. A statistician does not select nor treat figures to prove a misnamed "conclusion."
3. If source material is furnished him on condition that the respondent should not be specifically identified, he preserves this anonymity.
4. If a study of a confidential nature is made, the statistician preserves the confidence of his client or employer.
5. He does his utmost through logic and diplomacy to prevent the misuse of figures prepared by him, and if such misuse come to his attention, he gives proper warning, within the limits imposed on him by the requirement that he preserve the confidence of his client or employer.
6. In drawing conclusions from samples, he uses his best judgment. If valid tests for probability cannot be made, or (in biology, for example) if valid tests through repetition have not been made, he gives proper warning.
7. As a research worker, a statistician resists the temptation to interpret his results unwarrantedly as confirming his hypothesis.
8. A statistician keeps his employer or client informed of the meaning of figures and of the statistician's code of ethics, so that his employer may avoid improper requests. With logic and diplomacy he does his utmost to maintain his integrity.
9. A statistician authorizing a survey assures himself of the necessity of the work and of the likelihood of obtaining significant results.
10. He does not pick his figures to satisfy the social or economic or political views of any special pleaders.
11. A statistician trains his subordinates not only in competence but also in intellectual honesty, and by his example as well as by formal or informal training instills in them the principles of this code of ethics.
12. A teacher of statistics trains his students to look for the meanings which lie behind figures, and to use statistics honestly. He indoctrinates them with the highest ethical standards.

Here we come back to Mr. Brown's statement of ideals. Two of them, the first and the fourth, have substantially the same basic ideas as in the statement I have just read. Should the other four also be included in the document? The two statements are of course radically different in style, because written for different purposes, but the central purpose of each is to promote more honesty in statistics.

MORE NEWS

Course in Federal Workmen's Compensation Statistics

As a supplement to the Bureau of Employees' Compensation's on-the-job statistical training conducted daily from March 6 to June 15, 1951 the Statistical Branch has an informal, more advanced type of course in Federal workmen's compensation statistics which began September 12th. It is presented for employees by Mr. Edward F. Brayer, Chief Statistician of the Bureau of Employees' Compensation of the U. S. Department of Labor.

The Course traces the history of the workmen's compensation movement, with special emphasis on the role of the Federal government in the social insurance movement; the impact of adequate and timely statistics on the progress and development of workmen's compensation; and the basic and more advanced statistical tools used in summarizing present day compensation reports. The course is designed to foster and develop *individual* progress in various phases of statistical technique over a wide range, from the simpler to the more complex considerations, including multiple correlation and forecasting devices.

The course is not intended to develop professional statisticians. It presupposes a minimum of mathematical knowledge, and attempts to advance each individual in statistical understanding and ability commensurate with his or her interest and aptitude. It is planned as an integral part of the Bureau's program for the conservation, development, and utilization of manpower initiated under the President's Management Improvement Program.

Former on-the-job statistical training was largely limited to advancement in the application of coding principles, case history evaluation processes, improvement in typing statistical tables, skill in the use of calculating machines, and similar administrative devices.

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index with fixed weights cannot yield a quantity index expressed in "constant" dollars of the base period. Two other comfortable notions likewise have to be rejected: that the choice of a weighting period is inconsequential and that the shift of a quantity index from one time base to another also translates the weight base. Furthermore, if we wish to express gross national product in "constant" dollars, we must use a deflator which is not only suitable in scope and formula but also analogous in structure. Thus, if the national product is conceived as the sum of weighted outputs reduced by the sum of weighted inputs (of materials, etc.), then the price deflator must also contain corresponding positive and negative aggregates.

Many aspects of production measurement require closer study. The notion of "physical volume" is metaphorical at best; its pristine clarity vanishes with the introduction of weights, attempts at adjustment to a "net" basis, the introduction of "services" in input terms, the desire to adjust for quality changes (too lightly assumed to be "improvements"), etc. The common methods of handling changes in the product universe (like chaining and the application of the value-coverage adjustment) tend to impart a downward bias when new products are introduced. There ought to be some experimentation with another method—the extension of the familiar aggregative indexes to include items which can have zero quantities and (according to the date of the weight base) may be assigned hypothetical weights. For areas in which significant measurement is impeded by the extreme heterogeneity of end products (e.g., machinery or construction), the compilation of data by "subproducts" (the outputs corresponding to "arcs" of full production cycles) ought to be considered.[3] Subproduct measures would tend to be invariant to changes in degree of technical integration, to correspond closely to the structure of activity, and hence to yield more significant productivity measures. Subproduct indexes could differ greatly from the customary "gross" (e.g., value-weighted) end-product indexes for individual manufacturing industries; and the latter, in turn, must not be assumed equivalent to preferred net output measures based on reduced aggregates or on end-product series with partial (e.g., value-added) weights.

Many problems of productivity measurement and interpretation involve the production numerator, but some do not. The composition of the non-labor input index required for total-factor productivity measurement needs to be clarified. A distinction must be made between labor productivity measures computed as internal averages of productivity relatives and those computed as quotients of output and labor-input measures. With proper weights, the two can be made identical; but, typically, the quotient is factorable into an average of productivity relatives and an index showing the shift in output structure, so it need not lie within the range of productivity relatives. Finally, the virtues of the labor productivity concept must not be overlooked in the zeal to point out that labor alone is not technically responsible for the output associated with it—a fact which even Marx would not have denied.

Now, a word about base periods.[4] It is not generally known that a compound time base—like 1935-39 or 1947-49—is awkward for cases in which further operations, like multiplication or division, have to be performed on indexes already constructed on such a base. Since the products or quotients (unlike the original indexes) may not average to 100 for the base period, the true averages must be ascertained before any quotient or product can be correctly interpreted. When monthly series are involved, ascertainment of these averages requires a large amount of extra computation. Finally, the notion that a base period represents a "normal" may be satisfactory for cyclical studies—but not for studies of secular growth, which is characterized by rising money prices, production, and productivity.

IRVING H. SIEGEL

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[1] The position taken in this paragraph and the next differs from that expounded in Professor Mudgett's new book, *Index Numbers* (1951).

[2] Many of the points made here and in the next two paragraphs were elaborated in two papers presented at the 110th Annual Meeting (1950) of the American Statistical Association, "Progress and Problems of Production Measurement" and "A Half Century of American Productivity Measurement."

[3] See the writer's article, "The Concept of Productive Activity," *Journal of the American Statistical Association*, June 1944, pp. 218-28.

[4] See the writer's "A Note on the 1935-39 Standard Base," *Bulletin of the American Statistical Association*, March 1942, pp. 198-99.

WANTED

Back issues of the *Journal of the American Statistical Association*. If you wish to dispose of your copies of the following issues of the *Journal*, write to the Office of the Secretary of the Association:

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Volume 31, No. 196, December 1936
Volume 33, No. 203, September 1938
Volume 35, No. 210, Part I, June 1940
No. 210, Part II, June 1940
Volume 36, No. 213, March 1941
Volume 42, No. 238, June 1947
Volume 42, No. 239, September 1947

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CHAPTER NOTES

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CENTRAL NEW JERSEY

The January meeting of the Central New Jersey Chapter was devoted to a discussion of "Some Prewar Aspects of National Variables in the Unemployment Compensation System." William Netschert, Secretary-Treasurer of the Chapter, spoke on "Can the Techniques of 'Operations Research' be Applied to the Published Data out of that System?"

Gladys Ellsworth, Chief of Research and Statistics of the State Department of Conservation and Economic Development, has been appointed chairman of a provisional committee on census tracts and related use of census statistics. The Chapter is cooperating with the National ASA Committee on Census Enumeration Areas in promoting a fuller use of census tracts.

CONNECTICUT

At the annual meeting of the Connecticut Chapter, the following officers for 1952 were elected: President, Geoffrey Beall; Vice President, David Pinsky; Secretary-Treasurer, Roger Stark; Executive Committee, William Haenszel and David F. Votaw, Jr.

DAYTON

Officers elected for the 1951-52 year were as follows:

President.....Klein C. Gilhousen
Vice President.....Mrs. Freda W. Kurtz
Secretary-Treasurer.....Gene K. Wentz
Program Chairman.....Kenneth V. Casey

The September meeting was held in conjunction with the American Society for Quality Control. D. L. Lobsinger, Superintendent of Quality Control for United Airlines, discussed "Recent Applications of Quality-Control Procedures in Scheduling In-flight Meals and in Reducing Clerical Error in the Handling of Ticket Reservations."

At the October meeting, John W. Main, Director of Research for the Ohio State Department of Public Welfare, spoke on the "Application of Sampling Techniques to the Workload of Welfare Cases."

Dr. Warren S. Thompson spoke at the November dinner meeting. Dr. Thompson, who is Director of the Scripps Foundation for Research in Population Problems, Oxford, Ohio, discussed "Some of the Major Implications of Recent Demographic Trends."

DENVER

Richard H. Blythe, Jr., spoke at the January meeting of the Chapter on "A Probability Sample of the Population of Greece." Mr. Blythe worked with W. Edwards Deming in making this population study.

HAWAII

The December meeting of the Hawaii Chapter was held jointly with the Census Sub-Committee of the Chamber of Commerce, A. Ross Eckler, deputy director of the Bureau of the Census, reported briefly on the International Statistical Conference held in New Delhi during December and summarized the paper which he had given in India on "Accuracy of Survey Data."

Officers elected for 1952 were:

President.....L. P. Carter
1st Vice President.....Richard Takasaki
2nd Vice President.....Albert L. Tester
Secretary-Treasurer.....Fred Colland

NEW YORK

In addition to the special meeting at the United Nations on Feb. 29th, four other meetings are scheduled for the month of March. On the 7th Geoffrey Moore and H. H. Scaff will discuss "Short & Long-Range Forecasting" and on the 14th, E. J. Gumbel of Stanford University will present a paper, "The Extreme Duration of Human Life." Both of these meetings will be held at 315 4th Ave. On March 20th, A. Ross Eckler of the U. S. Bureau of Census will give us an evaluation of the 1950 Census results. "The Role of Statistics in Operations Research" will be George E. Kimball's topic on March 25th.

PHILADELPHIA

The first dinner meeting of 1952 heard Robert B. Mitchell, of the University of Pennsylvania, speak on the topic, "Toward a Research Basis for City Planning."

UNIVERSITY OF ILLINOIS

On October 29, Raymond B. Cattell, Research Professor of Psychology, spoke to the University of Illinois Chapter on "Statistical Determination of Historical Influences in Psychological and Economic Data."

On November 26, Dallas W. Smythe, Professor of Economics, spoke on "Designing a Study for Television Program Analysis."

On December 17, S. A. Kirk, Professor of Education, and Irene E. Harms, Research Assistant Professor of Education, spoke on "Experimental Studies in Educating Retarded Children."

WASHINGTON

The January meeting heard Gerhard Colm, of the Council of Economic Advisers, speak on "Can Statistics Aid in Policy Guidance?" and Myer A. Girshick discuss the "Contributions of Abram Wald."

MORE NEWS

Quality Control Short Course for Wood Technologists

A five day course in Quality Control for Wood Technologists was held at North Carolina State College during the week of September 10th to 14th. The course was sponsored by the School of Forestry with the cooperation and assistance of the Institute of Statistics. Approximately twenty-five representatives from wood manufacturing industries in eleven different states attended. Faculty participants included: J. S. Bethel, Director, Wood Products Laboratory, N. C. State College; R. J. Hader, Institute of Statistics, N. C. State College; Milton Terry, Department of Statistics, Virginia Polytechnic Institute, Blacksburg, Virginia; E. S. Johnson, Professor of Furniture Manufacture and Management, School of Engineering, N. C. State College; C. A. Bicking, Office of Chief of Ordnance, Washington, D. C.; Charles Latimer, Nickey Brothers, Inc., Memphis, Tennessee; P. B. Proctor, Lt. Col., U. S. Air Forces, Air Materiel Command; E. B. Windisch, Naval Materiel Inspection Office, Atlanta, Georgia; D. H. Schwartz, Quartermaster Corps Inspection Service, New York, N. Y.

Material presented covered the following topics: (1) General Theory and Construction of Control Charts, (2) Quality Control in Lumber and Veneer Manufacture and Procurement, (3) Quality Control in Wood Machining Operations, (4) Applications of Control Charts to Gluing and Finishing, (5) Chemical Wood Conversion, (6) Acceptance Sampling, (7) Quality Control and Acceptance Sampling in Military Procurement, (8) Organization of a Quality Control Program.

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